

far from that required to ignite fusion, but sufficient to demonstrate the formation of a hot plasma.

Given the long and arduous history of nuclear fusion research, we expect that the pathway to a demonstrated fusion technology for space applications will involve a series of ever-increasing (in size) and sophisticated experiments. The first such experiment would be to expose a small number of droplets in a prototype reaction trap to antiprotons confined in the High Performance Antimatter Trap (HiPAT), currently under development at the Marshall Space Flight Center (MSFC). HiPAT is designed to hold a maximum of 10^{12} antiprotons.

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GAMMA RAY ASTRONOMY

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The members of this discipline are almost equally divided between UAH and USRA in collaboration with the NASA/MSFC Physics and Astronomy Division. Dr. William Paciesas UAH is team leader for this group's effort. See the USRA Report for Gamma Ray USRA activities. The project has progressed successfully during this period of performance. The highlights of the Gamma Ray Astronomy teams efforts are: (a) Support daily BATSE data operations, including receipt, archival and dissemination of data, quick-look science analysis, rapid gamma-ray burst and transient monitoring and response efforts, instrument state-of-health monitoring, and instrument commanding and configuration; (b) On-going scientific analysis, including production and maintenance of gamma-ray burst, pulsed source and occultation source catalogs, gamma-ray burst spectroscopy, studies of the properties of pulsars and black holes, and long-term monitoring of hard x-ray sources; (c) Maintenance and continuous improvement of BATSE instrument response and calibration data bases; (d) Investigation of the use of solid state detectors for eventual application and instrument to perform all sky monitoring of X-Ray and Gamma sources with high sensitivity; (e) Support of BATSE outreach activities, including seminars, colloquia and World Wide Web pages. The highlights of this efforts can be summarized in the following publications and presentation list.

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COSMIC RAY ASTRONOMY

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The cosmic ray division participation in the cooperative agreement was activated in the second year. The scientific goals will be analysis of cosmic ray data from the Japanese-American Cooperative Emulsion Experiments (JACEE). Measurements of primary cosmic rays in the JACEE emulsion chambers will be made to derive for each detected particle the deposited energy in the chamber and the primary charge (atomic number). The data will be corrected to the primary flux above the atmosphere, and the composition and energy spectra will be derived. The spectra of the individual elements will be interpreted in context with the supernova shock and other models of cosmic ray acceleration.

Elemental Abundance of High Energy Cosmic Rays by Antarctic Balloon Flight Experiments. The UAH JACEE team in collaboration with the NASA/MSFC team has carried out a series of balloon flight experiments to explore the elemental composition of these high energy nuclei for the first time, directly measuring the primary charges and energies with emulsion chambers. We performed (1) detector designing, (2) emulsion materials production, (3) balloon flights, (4) post-flight processing, (5) photometry and scanning of events, and (6) cosmic ray event tracing in the detector. At high energies above 100 TeV/n ($\sim 5 \times 10^{15}$ eV for Fe), a spectral break (- Knee -) has long been recognized by the Extensive Air Shower (EAS) observations. Interstellar and supernova shock acceleration mechanisms encounter a great theoretical difficulty at this very energy region. Experimental data were, however, limited to the indirect energy flow spectrum and the data on the elemental abundance were missing. The JACEE group's balloon flight experiments with emulsion chambers has landmarked the first direct measurements of cosmic rays at the critical high energy region. Very high energy spectra of cosmic ray nuclei have been analyzed. From a total of 12 balloon flights, with an exposure factor of about 580 square-meter hour, the world's largest to date, the energy spectra of cosmic ray nuclei have been obtained in the energy range from several TeV to 1,000 TeV. The proton energy spectrum extending to several times 100 TeV showed a single-power law with some deficiency of statistics above 50 -